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CAN WE PREDICT EARTHQUAKES?

(This is an unsensational statement on the earthquake problem by one of America's leading seismologists. Is there danger of earthquake in California, New England, and elsewhere in the United States? Dr. Willis states the facts and the reader can draw his own conclusions.)

By Dr. Bailey Willis

Professor Emeritus of Geology, Stanford University.

"All I know is what I read in newspapers", as Will Rogers says. At least that is true as regards "predicting" earthquakes. Prediction connotes precision and precision spices news. Hence news predicts precisely. There will be a destructive earthquake shock in Wall Street in two years, two months, and a day. That, telegraphed by an irresponsible reporter is news, though not true. There have been severe earthquake shocks in New England. They are sure to occur again sooner or later. Common sense demands that we take precautions against disaster. That is not news, though true.

Earthquake news, served up as a kind of side dish, is overspiced. It is time for seismologists to give the public plain food. Certain facts we know; others we think we know; still others we infer confidently; others doubtfully; then we guess. The prediction of an earthquake is a guess, which I prefer to call a forecast.

We know that earthquakes are natural phenomena, which have occurred from time to time, at longer or shorter intervals, with greater or less violence, but unequally as regards time-intervals and intensities in different countries.

If earthquakes were like comets they would return at definite intervals. But they do not resemble comets in any respect whatever. Rather are they like storms, an effect of concentrated energy; gathered in the one case in the air and reaching a crisis at frequent intervals; in the other case gathered in the earth's crust and rising to a critical state at longer intervals. That much we know regarding their periodicity and we can say with confidence that the farther we are from the last great shock, the nearer we are to the next one.

We know that sometimes, but not always, earthquakes group themselves in a district in a brief sequence of years. We recognize in those cases what we call fore-shocks, a relieving shock, and after-shocks. When we have a full series there

is no difficulty in distinguishing the several parts of the sequence. The fore-shocks are moderately severe and limited in their effects to a small area. The relieving shock is one of great intensity and large area. The after-shocks gradually diminish in intensity and frequency. In case of a moderately severe earthquake, however, such as the Santa Barbara incident, we cannot know definitely to what extent it may have served as a relieving shock for that locality or in what manner it may have relieved adjacent districts of strain, or have increased the strain upon them. Here we begin to guess.

We may be guided in guessing by related facts and may feel more or less justified accordingly. Thus the historical record shows that southern California is a province which has been shaken from time to time by earthquakes of a general character. In 1857 the disturbance was strong over an area of some 250,000 square miles. That is, it compared in extent with the earthquake of February 28, 1925 in the eastern States, but it was much more violent. The Santa Barbara shock, by contrast, shook an area that did not exceed 3000 square miles and points of high intensity were curiously limited and sporadic. The energy released in the latter case was not more than one percent., very likely not one tenth of one percent. of that set free in 1857. The 1857 shock was a relieving shock. It was followed by a long interval of quiet. I would not feel safe in guessing that the Santa Barbara incident would have a like effect.

During the last seven years there have been four incidents of the Santa Barbara kind in southern California. We do not know that they are fore-shocks. We cannot know until the relieving shock shall have shown that they are. But we are on the safe side in guessing that they will prove to have been fore-shocks.

We think we know that earthquakes are produced by pressure which distorts the elastic rocks, so that when they slip they vibrate. It has been found by the Coast Survey that the mountains in California are on the move, so to speak; that is, they are pushed out of place, and we connect their movements with the pressure to which we attribute earthquakes. In southern California certain mountain peaks not far from Santa Barbara have moved northward, in the direction in which the earthquake pressure should push them, as we understand it. In northern California other mountain peaks moved northward until after the earthquake of 1906, but they then began to slide back southward. The shock of 1906 was a relieving shock for the north and we guess that it took off the pressure. The mountains in the south have not begun to slide back, so we think that the pressure has not been relieved, and this confirms our guess that the relieving shock is ahead of us.

Until recently we have had to depend upon our senses for evidence of nearby earthquake activity and we have been aware that their capacity to detect vibrations is limited to the greater ones. Thousands of minor shocks or micro-tremors occur daily and they would give us an index of the elastic strain in the rocks not unlike the significance of a barometer in weather observations, if we could but register them constantly. We have had instruments, it is true, that would record the occurrence of a great shock a thousand miles away, but they are not tuned to the more rapid waves of a local tremor. Through the researches of the Carnegie Institution of Washington, we now have available the Wood-Anderson seismometer, a simple, but very sensitive little instrument, which can be tuned to record elastic waves of any length, and we are thus in a position to know what the actual condition of the earthquake strain is in any district where the seismometers may be installed. We shall then guess more certainly, but we have to wait

until the value of that information is appreciated in San Francisco, New York, Boston, and elsewhere, at least to the degree that business interests will provide the instruments as a measure of self-protection.

In the mean time the seismometers have been made and tested at Pasadena, where they have proved their efficiency by registering as many as two hundred micro-tremors a year. This state of activity is not what we would expect during a period of quiet. It might occur before a relieving shock or soon after one, but in the latter case the great shock must have occurred recently, and that is not the fact.

To sum up for southern California: Sixty-eight years have passed since the last general earthquake; severe strain is indicated by local shocks, displacements of mountains, and seismometric records; in 1852 a disturbance similar to that of 1925 preceded the relieving earthquake of 1857. Will history repeat?

For northern California the facts are: It is only 16 years since the greatest relieving shock recorded in that province; slight, though sensible tremors occur from time to time; they are not as strong as we would expect fore-shocks to be; the pressure which moved mountains has been relaxed. The best guess seems to be that the strain has begun to re-accumulate, but is not likely to reach a critical condition for two or three decades.

As regards New England we know that the conditions are very different from those in California. Intervals between relieving shocks are much longer; distinct fore-shocks have not been recognized; movements of mountain peaks may have occurred, but are unknown; seismometric records of micro-tremors are lacking. The St. Lawrence earthquake of February 28, 1925, no doubt relieved the strain within a considerable area. Does that area include New England? I do not know. Does it include New York? I cannot guess! The poverty of information is lamentable. We face two possibilities, as far apart as the poles: (1) the strain is relieved; we need not expect another severe shock in a century or two. Or (2) the strain is not relieved; it has been increased by the failure of one part of the continental structure, which brings the pressure to bear on another; if so, we may expect renewed activity soon. No light leads in either direction.

New York, Philadelphia, Washington are in a seismic belt where shocks have been so rare and so slight that we hardly expect them. It may be a safe guess that no earthquake of any severity will ever affect those cities. And yet - there was the Charleston earthquake of 1886! A great shock, its intrusion upon our fancied security gives one pause. I wish seismometers had been longer in use, that they were more generally installed today.

TETRAETHYL LEAD GAS FOUND NOT DANGEROUS

Tetraethyl lead "knockless" gasoline is safe to handle and use as fuel, though the anti-knock compound itself is still recognized as dangerous in its concentrated form. This is the gist of the findings of the special committee of the U. S. Public Health Service that has been investigating the problem brought up by the alleged "lead-gas" poisonings some months ago.

The committee examined 252 men, most of them car owners and users, employees

in garages, power plants and public service corporations in Dayton and Cincinnati, Ohio. Part of them handled and used gasoline treated with tetraethyl lead, and the others only untreated gasoline. One group of 60 was exposed to lead as a direct industrial hazard. Thorough physical examinations were made of all of them by doctors, who were not permitted to know which of their subjects were exposed to the ethyl-gas and which were not. The general tenor of the results of these examinations is to the effect that no health differences can be found among these men that can be traced to their exposure to the treated gasoline.

It was found that practically all of the men eliminated lead from their bodies, whether they were exposed to the suspected fuel or not. This indicated that they were absorbing lead from other sources. The committee found appreciable quantities of lead in the dust in garages, presumably from tires, battery plates, etc. The suggestion is also offered that lead may be taken in with drinking water, from plumbing consisting in part of lead pipes.

In addition to the lead in garages, the committee found that the air in the Dayton Municipal Garage contained from two to seven parts per ten thousand of the poisonous carbon monoxide gas when cars were operating.

Representatives of the American Federation of Labor, of the U. S. Public Health Service and of the manufacturers of ethyl gasoline are now drawing up a system of regulations to apply to the manufacture, blending and distribution of ethyl gasoline. These recommendations are expected to form a basis for any future state and municipal regulations on the subject. The sale of anti-knock gasoline, which has been voluntarily suspended during the investigation, will probably be resumed in a few days, except where prohibited by local authorities.

The committee summarized its findings as follows:

"On the basis of this investigation, the committee feels that the following general conclusions are justified:

"1. Drivers of cars using ethyl gasoline as a fuel and in which the concentration of tetraethyl lead was not greater than one part to 1500 parts by volume of gasoline, showed no definite signs of lead absorption after exposures approximating two years.

"2. Employees of garages engaged in the handling and repairing of automobiles and employees of automobile service stations may show evidence of lead absorption and storage, as indicated by the lead content of the feces and the appearance of stippled cells in the blood. In garages and stations in which ethyl gasoline was used, the amount of apparent absorption and storage was somewhat increased, but the effect was slight in comparison with that shown by workers in other industries when there was a severe lead hazard and for the periods of exposures studied was not sufficient to produce detectible symptoms of lead poisoning.

"3. In the regions in which ethyl gasoline has been used to the greatest extent as a motor fuel for a period of between two and three years, no definite cases have been discovered of recognizable lead poisoning or other disease resulting from the use ofethyl gasoline."

TEN YEARS KNOCKING THE KNOCK FROM AMERICAN "GAS"

Tetraethyl lead, the dope drops made to put into gasoline to take the cough out of the motor as it climbs a hill or pulls a heavy load, was the most perfect result of more than ten years' search on the part of American motor engineers for a means of getting more use out of gasoline.

The public is getting about 5 per cent. of the energy out of gasoline when it drives its motor cars, experts at the U. S. Bureau of Standards say. In a motor boat or airplane engine it has been possible to push up on a full load and get as much as 30 per cent., while at normal operation about 20 per cent. of the energy in gasoline is made use of.

A study of the working of the engines revealed that the greater the pressure of the gasoline and air mixture inside the cylinders where it was exploded, the greater the amount of energy obtained. But increased pressure above a certain point caused an objectionable knocking. It was possible that this might injure the motor and the driver was likely to think something was wrong with his car.

Tests with some of the heavier gasolines and alcohols showed that a high compression could be obtained without the knocking. An effort was made to modify the common gasoline used so that it would behave like these also. It was found that iodine and aniline added in small quantities of 3 and 2 per cent. stopped the knocking, and although it was out of the question to use either of these two substances because of their scarcity and high price, it gave the chemists and engineers an insight into the problem.

The problem, they said, was a molecular one. Some substances made knocking worse and some made it better. Substances of high atomic weights turned out to be the most effective anti-knocks. Following that fact, and for no other reason at all, scientists tried lead, because it was probably the heaviest common substance that could be easily obtained.

After trying out many organic preparations containing lead, a synthetic substance, tetraethyl lead, was finally hit upon and found successful. Quantities as small as one thirteenth of one per cent. took out the knock of an engine under strain, compared to the 3 and 2 per cent. of iodine or aniline required. Like all lead compounds, this substance was poisonous.

Since then, physiologists and chemists of government and industrial laboratories have been busy finding out whether this substance is dangerous to public health both in its manufacture and its use. The problem is important because America uses over a million gallons of gasoline in an hour.

LEADED GASOLINE RENAMED TO INSURE SAFETY

"Motor fuel" instead of "gasoline" is the label which gasoline treated with tetraethyl lead, the anti-knock compound, will wear when again placed on the market.

The committee of the U. S. Public Health Service, which, after investigation decided to allow the sale of leaded gasoline, provided for this safeguard of the public.

If leaded gasoline were sold as"gasoline" many housewives, mechanics and others using it as a cleaning fluid might become poisoned through absorbing in their bodies the lead it contains. The new label, "Motor fuel", will show that leaded gasoline is to be used for power generation only.

Scientific members of the committee, representatives of state health departments. manufacturers and distributers who decided on the change, also agreed to make the places where the poisonous, concentrated tetraethyl lead fluid is added to the gasoline as few as possible, so as to lessen the danger to workers.

WARNS PRINTERS' AGAINST LEAD

A warning to printers and molders of type metal has been issued by Dr. C. V. Weller, University of Michigan. Dr. Weller is studying lead poisoning experimentally, taking guinea pigs as the subject for his investigations.

Citing the fate of three young typesetters in Vienna who have become afflicted with gangrene of the feet, the pathologist said: "This is certainly a case of lead poisoning."

"Injury from type metal is a more common manifestation of lead poisoning than is usually realized," he added.

The lead alloy usually finds its way into the system through the mouth, as when meals are eaten carelessly in a type foundry, or through the lungs, by inhaling flying dust. The metal does not enter through the skin, in Dr. Weller's opinion.

SUPERCHARGER TO CHANGE AUTO ENGINE DESIGN

Use of smaller engines in automobiles, only sufficient when operating normally to run the car on a level, but which by the use of a supercharger can be made to give enough power to take them up steep hills, may soon be a possibility, the Society of Automotive engineers was told at its recent meeting, by C. R. Short, of the General Motors Corporation.

Supercharging, Mr. Short pointed out, consists in increasing the amount of gas and air mixture that the engine normally takes into the cylinders. This may be done by some sort of a pump or compressor to put the extra amount of the mixture into the cylinders, and so get more energy out of them. Such devices have been tried on automobile engines from the first days of the industry, but a great impetus to the use of superchargers has been given in recent years by their use in airplanes. By their aid great altitude records have been possible, whereas otherwise the low pressure of the rarefied air would not permit an engine to work. Racing automobiles also use them to get the greatest power out of their engines.

However, the speaker pointed out, mere increase of pressure in the intake manifold will only result in increase of power when the engine is working at top speed. What is needed, he said, is greaterpower when the engine is working at low speed.

"If this is possible," said Mr. Short, "the supercharger would not only provide greater power from the same displacement of the motor, but also greater flexibility, the lack of which in the present engine is the limiting factor in the utility of the internal-combustion engine. If this can be achieved, it would mean the modification of the transmission, which is the most undesirable part of the automobile."

An engine has been produced recently in Germany, he stated, for marine use which ordinarily develops 6,400 horsepower, but by use of an electrically driven compressor the power can be increased to 7,800 horsepower, an increase of about 22 per cent.

ACTUAL RUBBER SHORTAGE SEEN FOR 1930

The world's demand for crude rubber will exceed the supply by 37,000 tons in 1930 unless some plan of relief is adopted. This future shortage, which is actual, is troubling Congress almost as much now as the artificial shortage brought on by English restriction of rubber exportation which makes the price so high at present.

In hearings now being conducted by the Foreign and Interstate Commerce Committee of Congress to investigate the high price of rubber, Paul L. Palmerton, chief of the rubber division of the Department of Commerce, brought out that there were four methods by which Americans might combat the high prices caused by the present artificial shortage. One was a campaign for a more conservative use of what we have, making it last longer.

Substitutes were another possibility. Reclaimed rubber, although lacking some of the qualities of fresh natural rubber, could be mixed with new rubber in certain proportions for the manufacture of some articles wherein natural rubber had been used almost exclusively in the past.

In certain places, such as in the treads of tires, the use of reclaimed rubber decreased the durability. Tests on tire treads have shown that up to a certain point the durability is decreased regularly as the percentage of reclaimed rubber is increased.

Synthetic rubber has been unsuccessful commercially so far, although Germany, during the latter part of the war, was producing 150,000 kilograms of synthetic rubber per month. It is costly to produce and lacks elasticity, but it serves quite well in the manufacture of hard rubber products.

The stimulation of production of wild rubber in the Amazon Valley was another suggestion made by Mr. Palmerton, and the fourth was cooperative buying.

In view of the actual shortage which is prospective for us, he estimated that a million to a million and a half more acres ofrubber need to be planted upon plantations of our own. Rubber trees do not begin to bear until 5 to 7 years old and full bearing is not obtained until 8 to 10 years old, so trees planted now cannot hope to affect the prospective shortage of 1930 but they can

provide for the more distant future.

HOME GROWN RUBBER TRIED OUT BY GOVERNMENT EXPERTS

All the schemes to take a belated stitch inthe American rubber dilemma which resulted when Great Britain pulled in her supply are beset by difficulties. One of the least known of these schemes, although not necessarily the most unpromising, is that for growing rubber right here at home, under the semi-tropical sun of Florida and California.

The U. S. Department of Agriculture has been trying out seeds and plants of various rubber-producing species in experimental gardens, but as it takes a long time for the plants to mature and produce latex, officials have as yet no information to give out, and they are advising enthusiastic investors not to put any money as yet into Florida or California rubber.

Botanists name a long list of plants which will produce the milky sap containing rubber. The most important of these today is the Para rubber tree, Hevea guianensis. It grew originally in the Amazon Valley but was bootlegged out more than half a century ago by British planters who tried it out in Kew Gardens, London, and in Ceylon, to see if it would grow outside of Brazil. Then it was used to start the vast plantations in the East Indies that are now supplying the world with most of its rubber.

"Healthy seedlings of the Para rubber tree have been grown at the U. S. plant introduction gardens near Miami, and are being transplanted to different conditions of soil and exposure," Dr. W. A. Taylor, chief of the Bureau of Plant Industry, stated in his annual report to Congress. "The collection of rubber plants now growing at Miami includes altogether about twenty different types.

"Rubber plants that are natives of dry regions are being tested in California, in the coast regions as well as in the interior valleys," he continued. "Several dry-country rubber plants are known in Mexico, while others are reported in South America, Africa, and Madagascar. The production of rubber from the Mexican guayule plant has been investigated by a private corporation and the stage of agricultural practicability is believed to have been reached in California.

"Desert types of rubber plants are being grown in the lower valley of the Colorado River, and the possibilities of one of the common milkweeds are being studied because it grows well on waste lands and produces a large quantity of rubber-bearing material readily andcheaply. Cultivation might extend over large areas if ways of utilizing the substance were perfected.

"This plant is widely scattered in southern Arizona and the desert regions of Sonora and southern California, and it also grows in small ravines and gullies of barren hillsides a few miles from the coast of Lower California. Some of the plants grow so large that they form dense masses more than six feet high and ten feet across."

If any of the rubber-bearing species does show a willingness to produce

rubber in the United States in worth while quantities, many economic problems would still have to be solved before rubber growing could be done on a commercial scale.

Para rubber, if that should be chosen, would not have the even rainfall it has in the East Indies because Florida has distinct wet and dry seasons. With even rainfall, rubber trees may be tapped the year around, but with an uneven one, tapping would have to be seasonal. This would involve labor complications, because at certain times a great number of laborers would be needed, and at others only a few.

Even if that problem could be satisfactorily solved by secondary crops, there would still be a labor problem. East Indian rubber planters can get cheaper labor than Florida or California planters can ever hope to get. Therefore, some other means would have to be found to reduce the cost of producing the rubber in order to compete with England's East Indian product in price.

The research chemist would have to work out new means of getting the rubber out of the latex, certainly a cheaper and better way. In case one or more of the lesser known plants were to be used, for which no method of extraction is now known, a brand new method would have to be developed. On top of it all, the chemists might come along any day with a cheap synthetic rubber that would stretch as far as the best of nature's product.

NO EFFORT AT ALL FOR CHICK TO WALK

How can a newly hatched chick flutter out of its shell and run away from it, while a human infant must slowly learn to walk with many falls and bumps?

The answer is that the ability to stay right side up and well balanced is essentially automatic in the chicken, according to Drs. N. Kleitman and T. Koppanyi, of the University of Chicago. Many European scientists are devoting attention to the mechanisms by which a body rights itself. The experimental methods used by these Chicago physiologists were introduced from Holland.

Walking in human beings is really controlled by the brain, though the go, stop, and turn signals are so well known that the process seems to require no conscious effort. But in a chicken the position and movement of the body are automatic from the day it cracks the shell, and thus it can stand up unaided, the experiments show.

When a chicken's body is pushed from side to side, its head will remain in the vertical plane, with its beak pointing down, Dr. Kleitman explains. This is an automatic adjustment of position which depends on the labyrinth of the inner ear. When the bird is moved suddenly through the air, its wings and tail adjust themselves as steadying influences and to help it in landing on the ground. This is a reflex, or automatic adjustment, of movement.

"These different reflexes take place even when the brain is lacking, providing the labyrinths are intact," said Dr. Kleitman.

TABLOID BOOK REVIEW

Microbe Hunters, by Paul de Kruif. New York; Harcourt, Brace and Company, $3.50.

Dr. de Kruif has written a book that is so different from other popular science literature that it stands alone on a shelf. What Monsieur Maurois has done for Shelley in his "Ariel", what Miss Barrington has done for Byron in her "Glorious Apollo", what Mr. Strachey has done for Victoria, he has done for a dozen bacteriologists. By dramatizing their achievements, by putting their thoughts into monolog, by cutting out the unessential details of their lives and the technicalities of their methods, he has made them live again, and given the reader an unforgettable familiarity with them. He has avoided the common failing of biographers, that of being overawed by the great men of whom they write. He treats his heroes with a light touch never attempting to conceal their faults and frailities, wasting no time in empty eulogies, yet somehow they stand out all the greater from being handled as human beings, instead of pedestaled as demigods.

We know them all whether we were acquainted with them before or not. Pasteur we all know because he has been fortunate in his biographers. Metchnikoff also because he has been his own spokesman in his once popular book, "The Prolongation of Life." But Leeuwenhook has been to most of us merely a name, vaguely associated with microscopy, while Spallanzani has not even been a name. The author must have done a lot of digging into dusty volumes and dull reports to have got out his facts, yet his writing shows no trace of the digging, dust and dulness, but reads like a newspaper "story".

EDWIN E. SLOSSON

The largest motor-ship in the world, carrying 1,800 passengers, has just been built in England.

Ordinary black photographs can be transformed into sepia pictures by chemically combining them with sulphur.

More than 90 pounds of sugar is a year's ration for the average person in the United States.

Motor alcohol will not mix with motor grades of gasoline unless the alcohol is free from water.

Sirius, the Dog Star, has a satellite so heavy that it weighs 25 tons to the pint.
